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BLACK & VEATCH

Renewable Energy Transmission Initiative Phase 1B Update

Black & Veatch

Stakeholder Steering Committee

July 16, 2008

Agenda

- Phase 1B Work Group Items
  - Project Identification and Characterization
  - CREZ Identification
  - Transmission Methodology
- Draft Exclusion Maps

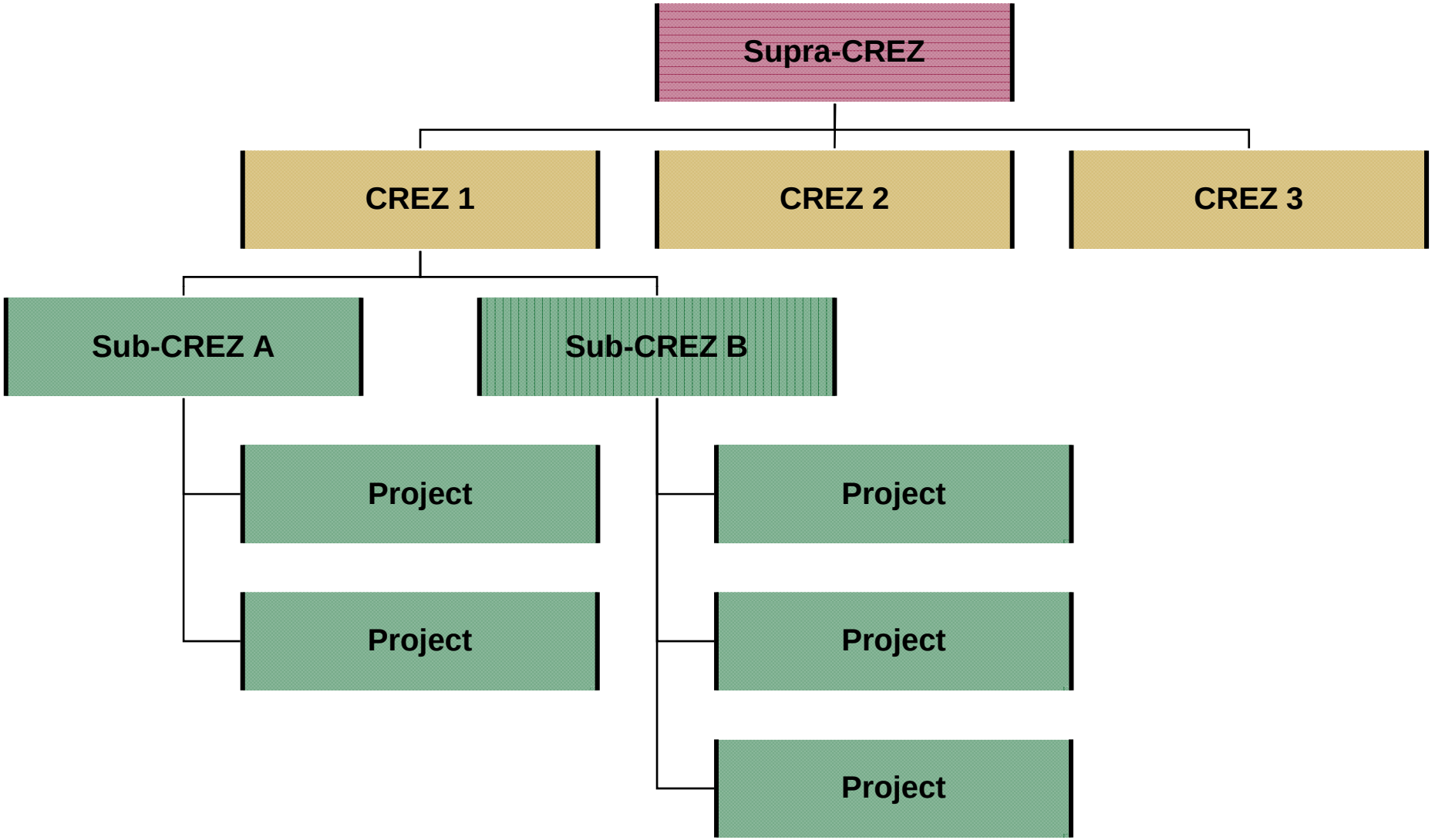
Phase 1B Work Group Issues

- Energy price forecast –reference and sensitivities
- Net short calculation
- Resource valuation model review
- Transmission assumptions
- Project characterization & identification
- Uncertainty assumptions - cost and CF data by resource type
- Advise on sensitivity analyses and data

TBD

TBD

RETI "Crezology"



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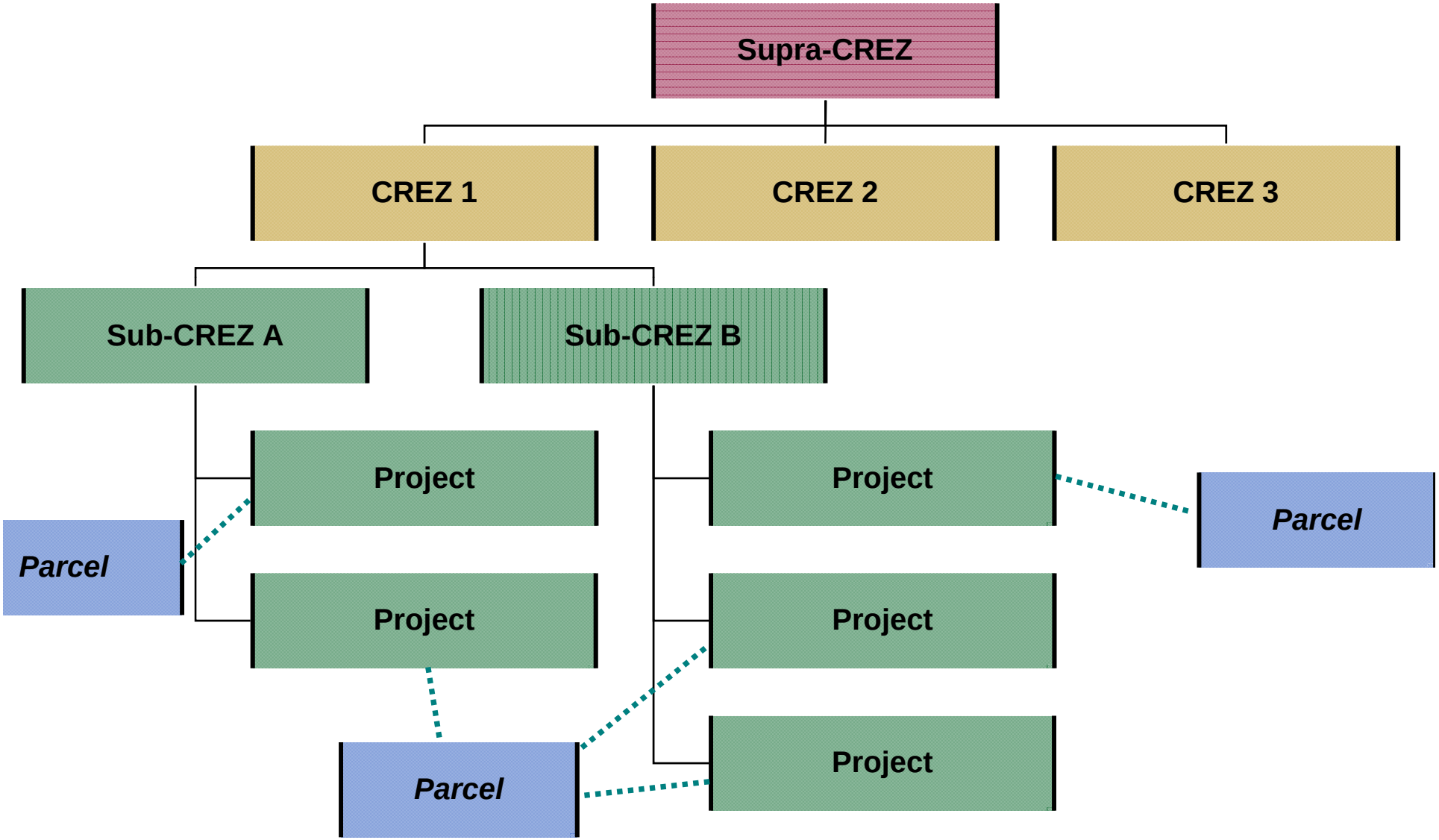
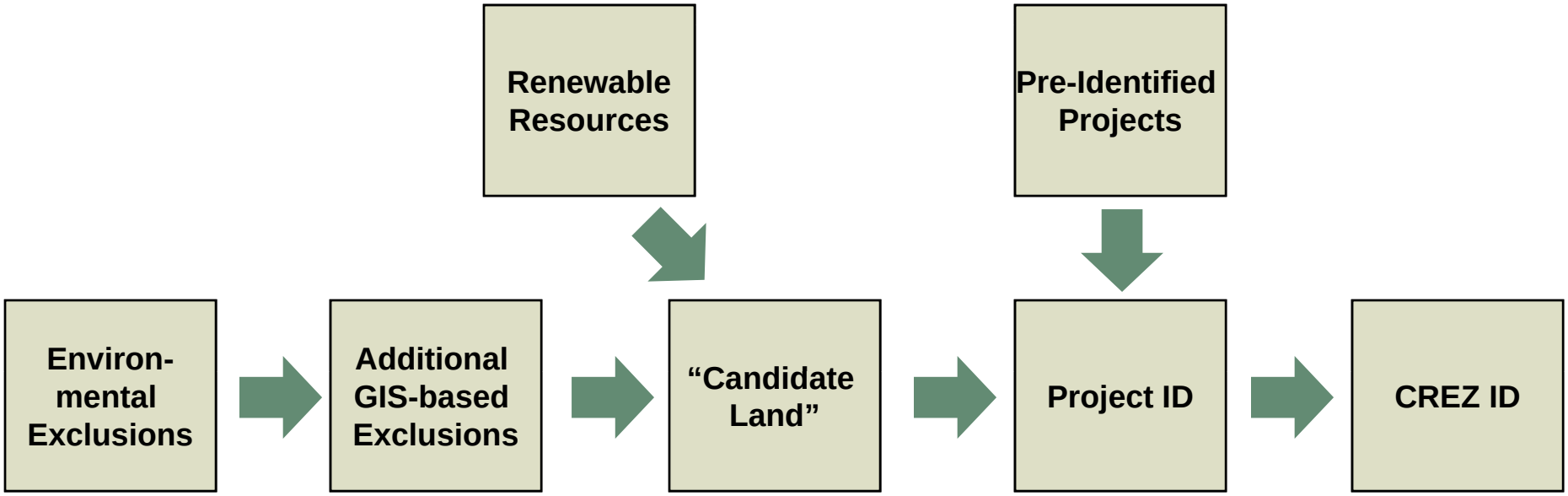


Generalized Project / CREZ Identification Process (Applies to almost everything)



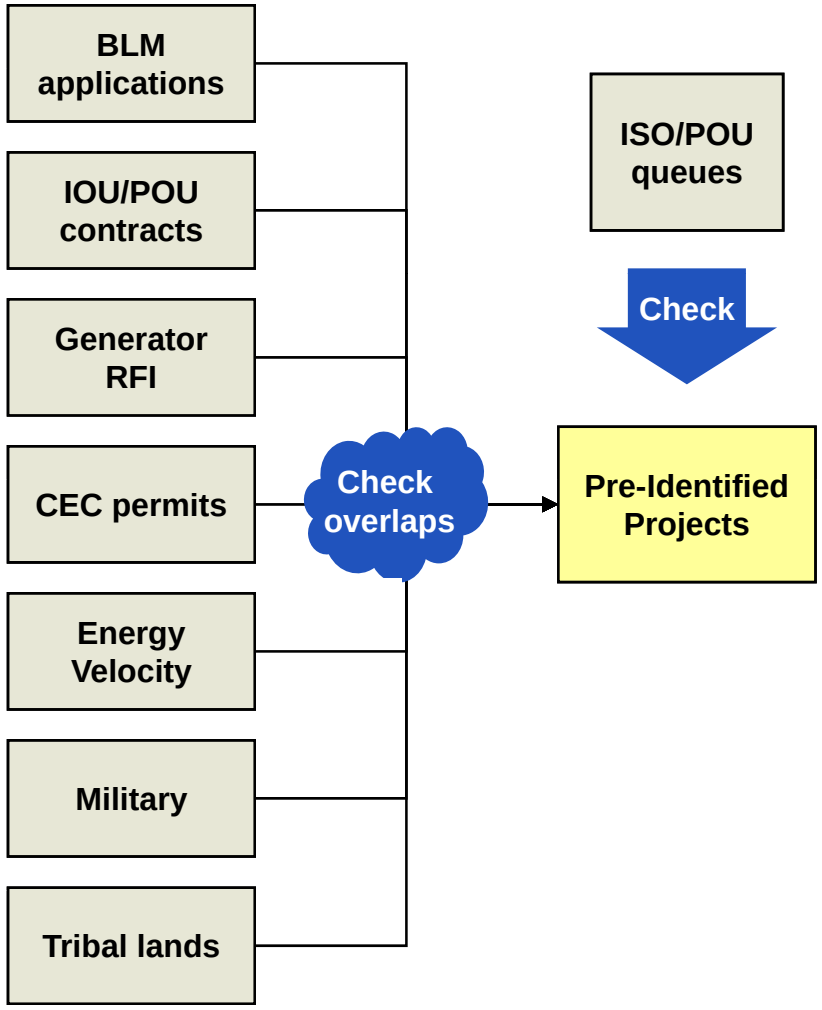
Project Identification and Characterization

Generation Projects

- **Pre-Identified Projects** – Areas/regions with some commercial interest or designation
  - Allows placement in otherwise restricted areas
  - Potential timing advantage
- **Proxy Projects** – All other projects identified by Black & Veatch
  - Avoid restricted areas
  - Default timing assumptions

Pre-Identified Projects: Sources

- Collect project data
  - BLM applications, IOU/POU contracts, Generator RFI, CEC Permits, Energy Velocity, Military, Tribal
  - Check for overlaps
- Check against ISO/POU queues by county
  - Projects should exceed ISO/POU queue totals for each county
  - Gaps will be filled with proxy projects



Pre-Identified Projects: No Capacity Information

- Some projects have land parcel information, with no capacity
  - For example, BLM wind applications with no capacity information
- B&V will fill the land parcel
  - Follow the proxy project methodology within the land parcel

Example Pre-identified Project Without Capacity Information

Pre-Identified Projects: No Parcel Information

- Some projects have no land parcel information
  - For example, IOU contracts with county and capacity information but no specific location
- B&V will place the project in the county
  - Follow the proxy project methodology within the county area

Example Pre-identified Project Without Parcel Information

Pre-Identified Projects: Generator Responses

- 18 responses to the Generator RFI
- 66 projects newly identified or verified
  - 21,497 total MW

Responses to the Generator Request For Information

	Wind	Solar	Geothermal	Biomass
# of projects	35	15	15	1
Locations	CA, NV, OR	AZ, CA, NV	CA, NV	CA
MW	11,421	8,092	1,973	11

Thank You to All That Have Responded!!!

Generation Project Characteristics

- Location
- Net plant output
- Capital costs
- Fixed operation and maintenance
- Variable operation and maintenance
- Heat rate (if applicable)
- Fuel costs (if applicable)
- Capacity factor
- Generation profile
- Land use
- Water use
- Where possible, identification of the affected sensitive species, such as bird and bat populations, or endangered species (this will be done based on GIS-information developed by the Environmental Working Group and the proposed project location)
- Air emissions

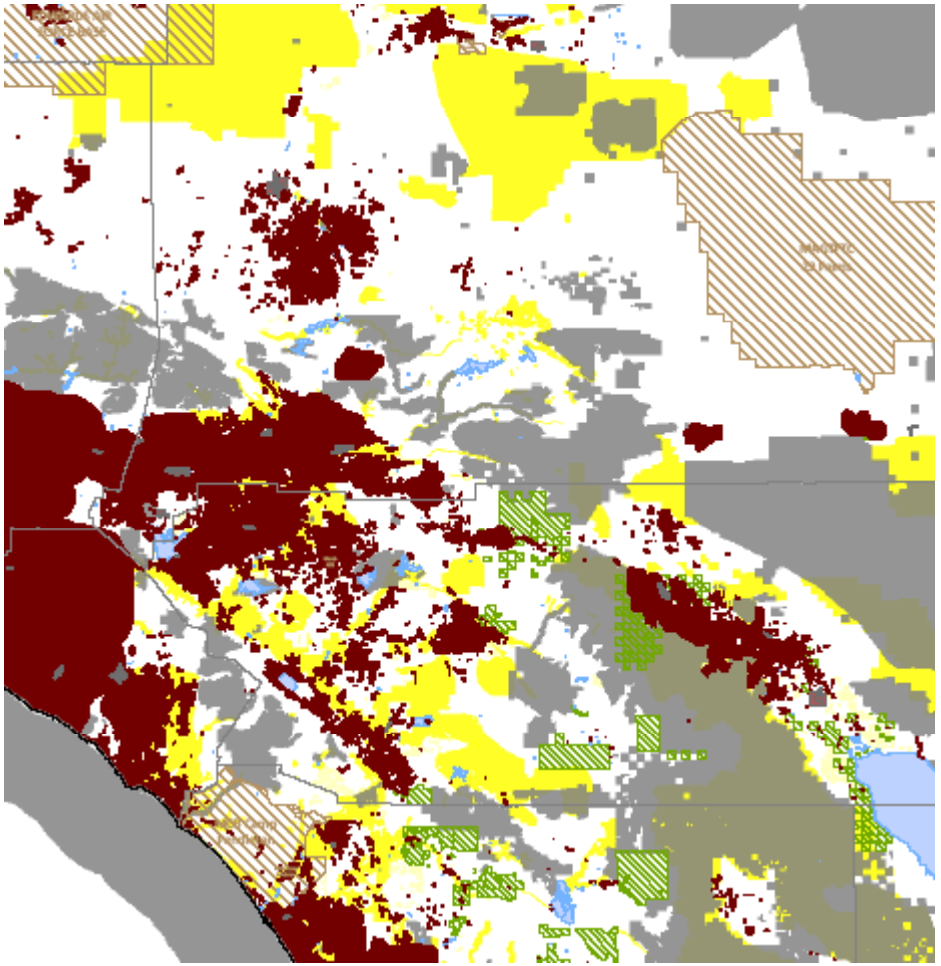
Common Resource Exclusions

(Biomass projects separately considered)

	Solar Thermal	Solar PV	Wind	Geo-thermal	Actions
Environmental black-out areas	Yes	Yes	Yes	Yes	
Environmental yellow areas	Yes*	Yes*	Yes*	Yes*	*Pre-identified projects allowed
Urban areas	Yes, +buffer	Yes, +buffer	Yes, +buffer	Yes, [illegible]	buffer up to 3 miles depending on population
Airports	Yes	Yes	Yes, +5 mi	Yes	Major airports only
Wetlands and water bodies	Yes	Yes	Yes	Yes	Dry lakes not excluded
Min. contiguous acreage	640	160	none	none	640 acres = 1 section
Land slope	< 2%	< 5%	none	none	Geothermal and wind to be evaluated on case by case basis
Native American reservations	Yes*	Yes*	Yes*	Yes*	*Pre-identified projects allowed
Military lands	Yes*	Yes*	Yes*	Yes*	*Pre-identified projects allowed
Mines (surface)	Yes	Yes	Yes	Yes	
Military flyways / radar	No	No	Yes* (Red)	No	*Pre-identified projects allowed in red zones. All other open.
Williamson Act Prime Agricultural land	Yes*	Yes*	No	No	*Pre-identified projects allowed

Resource Exclusions

- Base map distributed >
- Supplemental maps for each resource
  - Military flyway / radar
  - Williamson Act



List of Screened Resources

	CA	OR	WA	NV	AZ	Baja California	British Columbia
Solid Biomass	✓	✓	✓				✓
Solar Photovoltaic	✓						
Solar Thermal	✓			✓ (south)	✓ (west)		
Onshore Wind	✓	✓	✓	✓ (south)		✓ (north)	✓
Geothermal	✓	✓		✓			✓

Project Identification and Characterization – Solar Thermal

Proxy Projects

- Proxy projects will be developed in California as necessary to populate the analysis
  - Located on environmentally appropriate parcels

Out of State Projects

- Parcels with known commercial interest will be used to model projects in NV and AZ
- Import limitation is 2,500 MW in 2020

Project Identification and Characterization – Solar Thermal

All solar thermal projects will be modeled as a solar trough plant

- No thermal storage
- Dry cooled by default, wet cooled only with available recycled water

Capital Costs

Project capital cost may be adjusted for:

- Site topography which would result in increased earthmoving costs (slope dependent)
- Significant road construction required to access site
- Wet / dry cooling

Solar Thermal – Wet vs. Dry Cooling

- Cooling type will be based on availability of recycled water (treated municipal waste water)
- If recycled water available, use wet cooling
- All other plants assumed to be dry cooled
- Wet / dry not recommended as uncertainty issue
- Potential for lower water use with alternative / future technology to be noted

Project Identification and Characterization – Solar Thermal

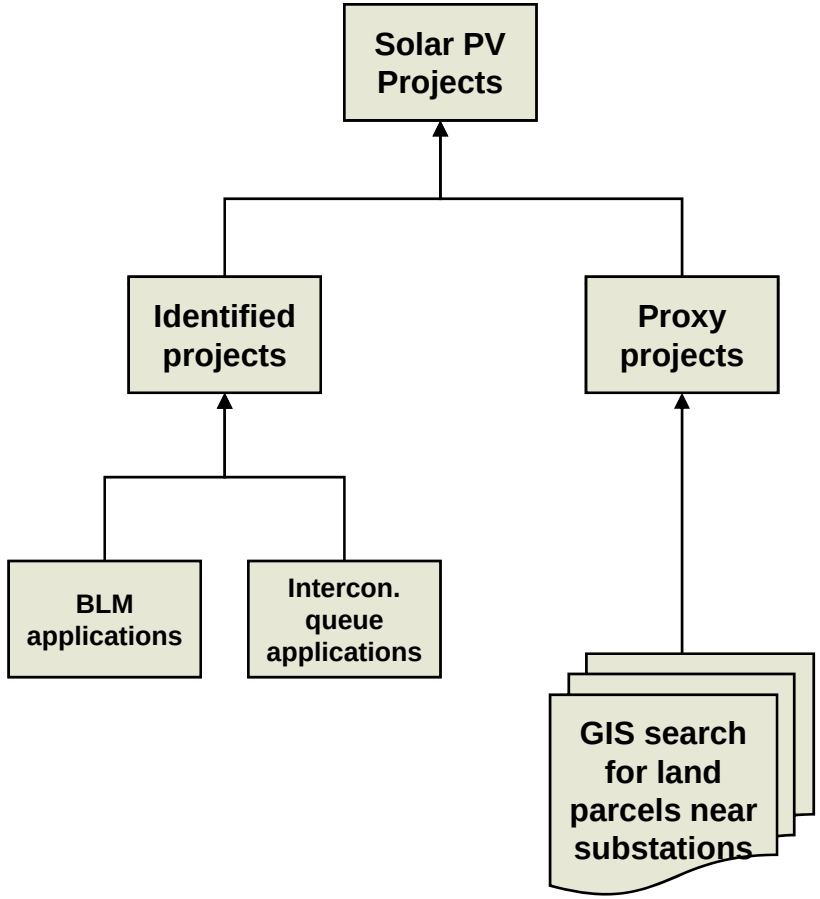
Plant Performance

Performance characteristics will be calculated by NREL's Solar Advisor Model (SAM)

- Capacity factor and production profile
- Insolation and meteorological data from satellite-derived data in the National Solar Radiation Database (NSRDB)
- Enough SAM simulations will be performed to capture climate effects on performance.
  - Where simulations are not performed for a project's specific site, the performance characteristics of a nearby performance run will be scaled based on the difference in monthly average insolation and latitude.

Project Identification and Characterization Solar Photovoltaic

- Identify solar PV projects from existing data sources
  - BLM applications
  - Interconnection queue applications
  - Generators and other sources
- Create proxy projects using GIS analysis
  - Agricultural or barren land
  - Excluding environmentally sensitive areas

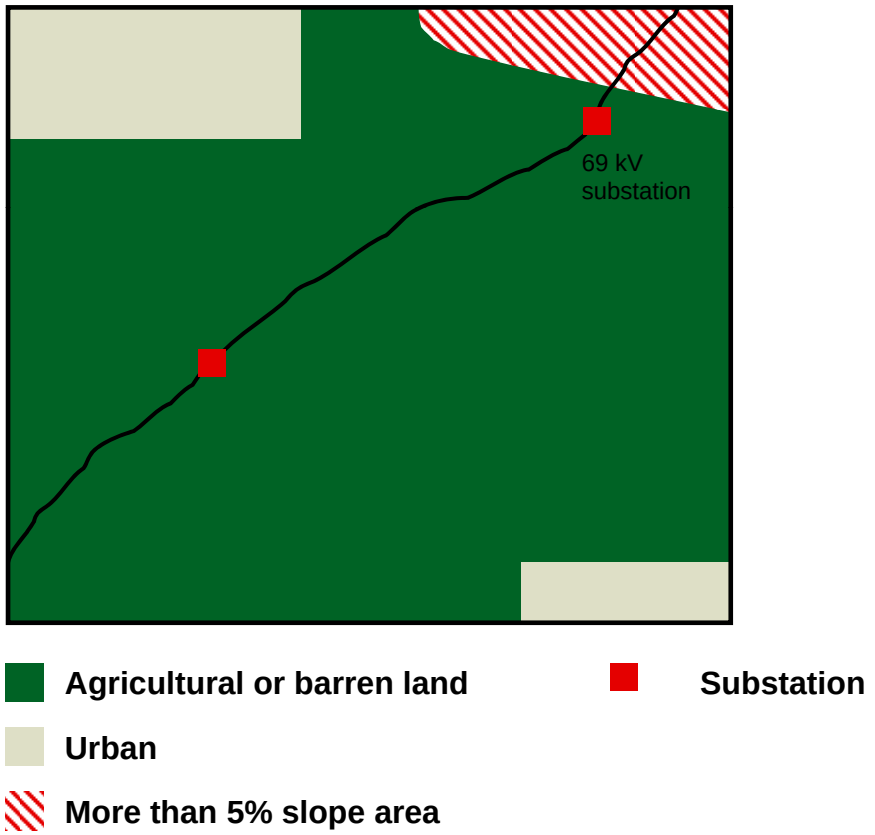


Project Identification and Characterization – Solar Photovoltaic Proxy Projects

Proxy Projects

- Initial criteria
  - Non-prime agricultural or barren land
  - less than 5% slope

Example Map for Solar PV Proxy Projects

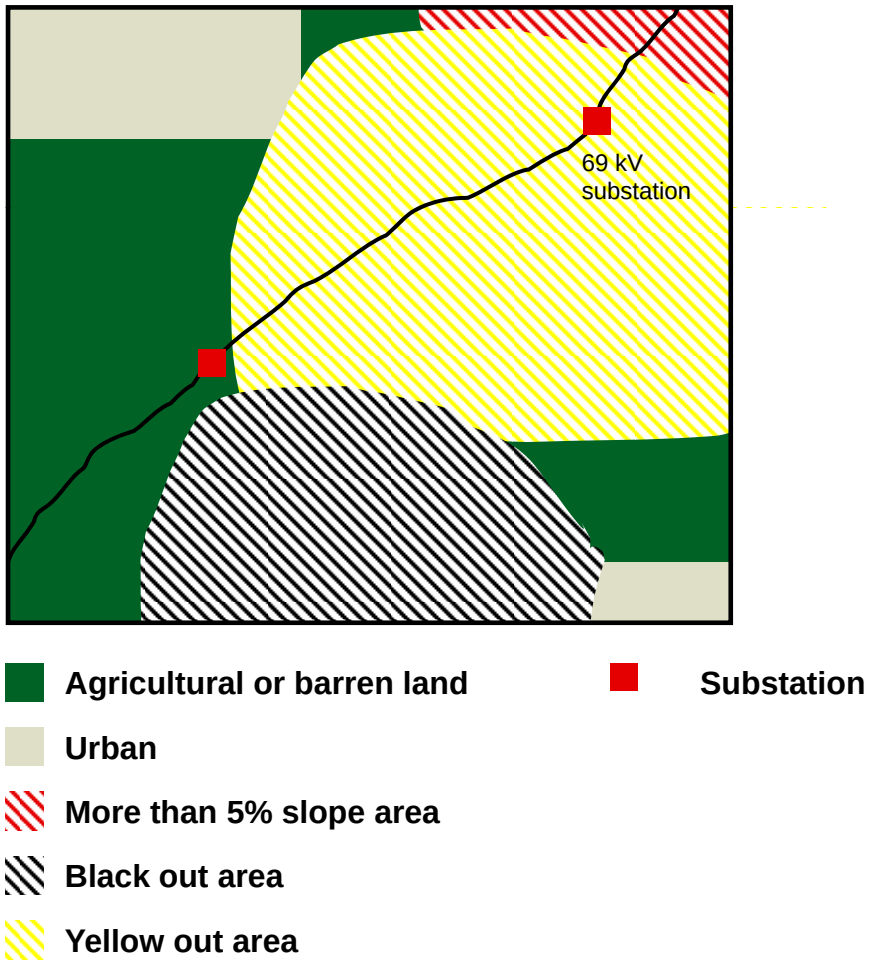


CONCEPTUAL – FOR EXAMPLE ONLY

Project Identification and Characterization – Solar Photovoltaic

- Initial criteria
  - Non-prime agricultural or barren land
  - less than 5% slope
- Environmental screen
  - Black out areas
  - Yellow out areas

Example Map for Solar PV Proxy Projects

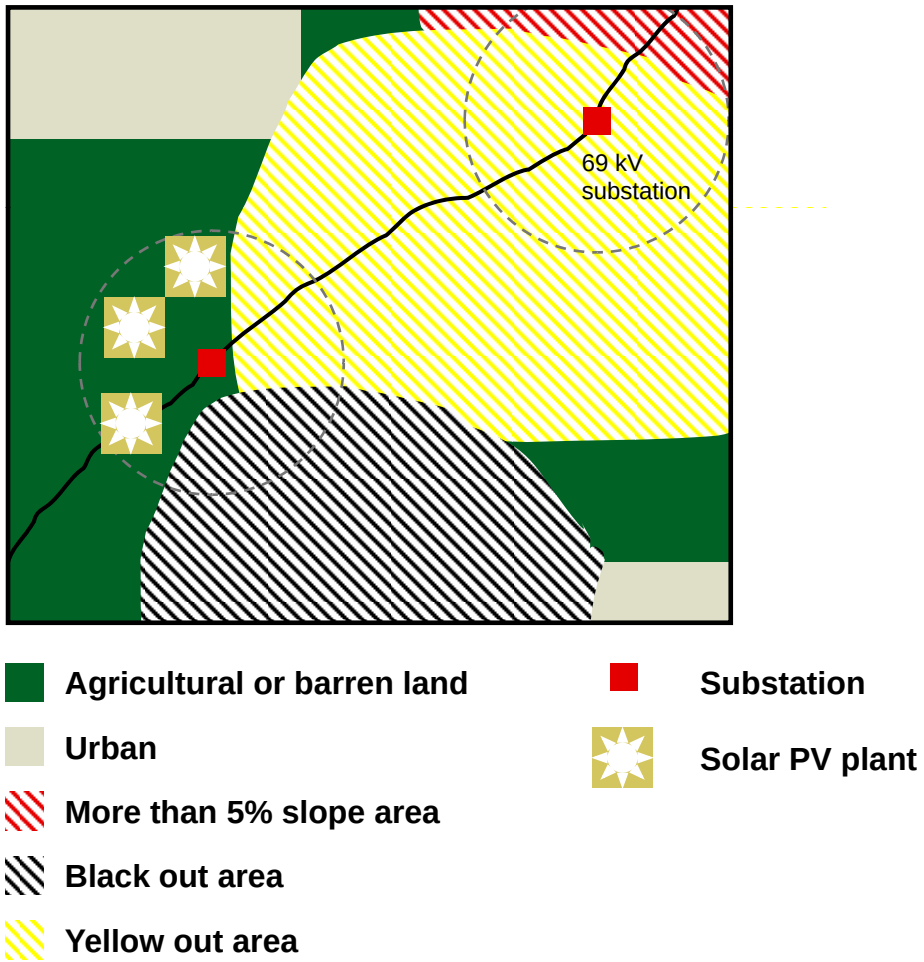


CONCEPTUAL – FOR EXAMPLE ONLY

Project Identification and Characterization – Solar Photovoltaic

- Initial criteria
  - Non-prime agricultural or barren land
  - less than 5% slope
- Environmental screen
  - Black out areas
  - Yellow out areas
- Land parcels
  - Continuous 160 acre plots
  - As close to substation as possible

Example Map for Solar PV Proxy Projects

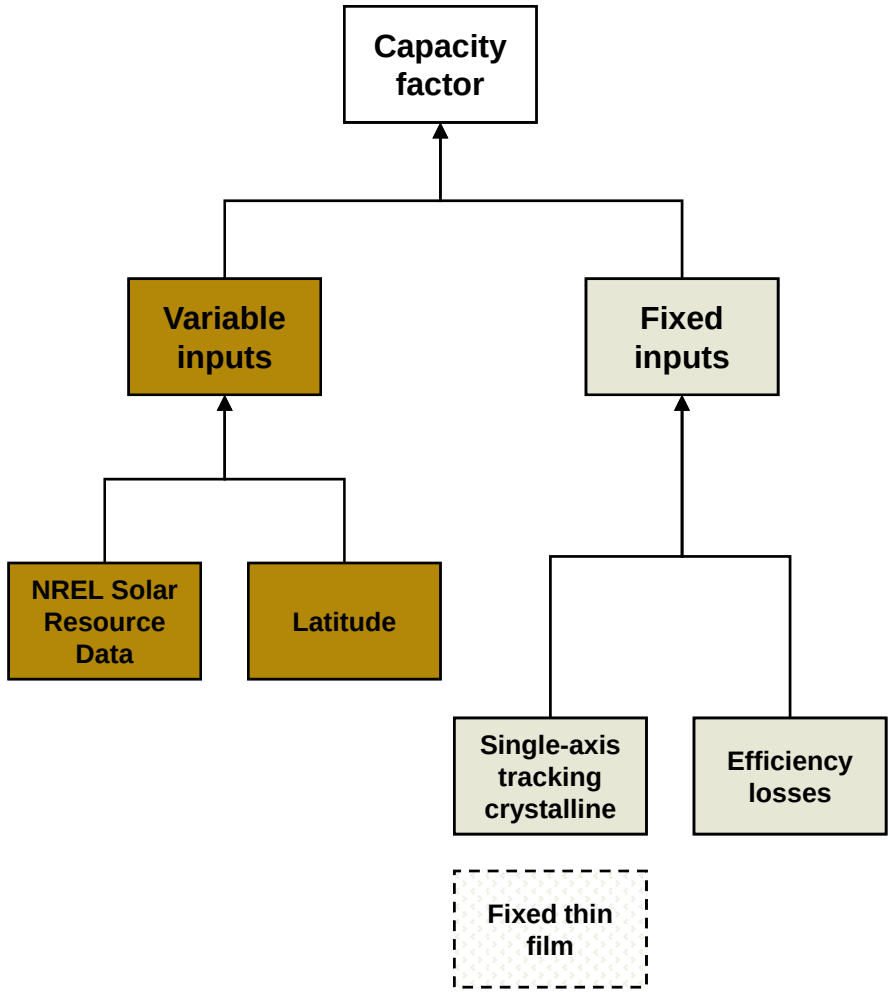


CONCEPTUAL – FOR EXAMPLE ONLY

Project Identification and Characterization – Solar Photovoltaic

Capacity Factor

- Variable inputs
  - High resolution NREL GIS solar data with monthly averages
  - Latitude for determining path of the sun
- Fixed inputs
  - Technology assumption
    - Base case: Single axis tracking crystalline
    - Sensitivity case: Fixed thin film
  - Efficiency losses to include soiling, inverter, wiring and other loss mechanisms

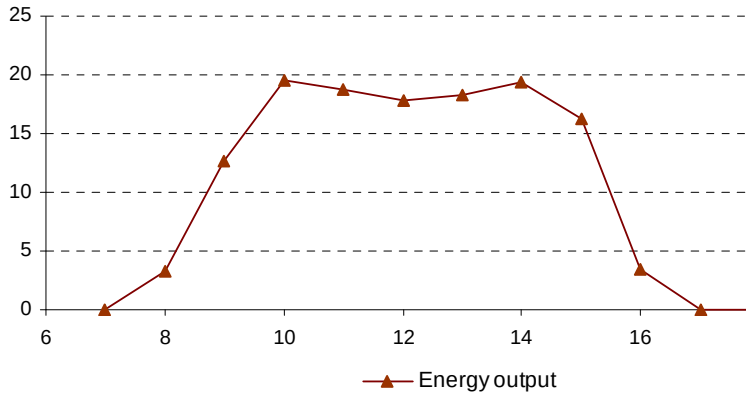


Project Identification and Characterization – Solar Photovoltaic

Production profile

- 12 x 24
  - Typical 24 hour production profile for each month
- Production profile variation drivers
  - Month of year
  - Latitude
  - Single axis vs. fixed tilt
  - Temperature (minor)

Example solar PV production profile single axis tracking (winter)



CONCEPTUAL – FOR EXAMPLE ONLY

Wind Projects - Siting

Proxy Projects

- Based on available land not identified or connected with other project data
- Meet requirements for wind resource, terrain, environmental sensitivity, military restrictions, etc.
- Best projects selected first

Out of State Projects

- Out-of-state projects will be modeled by wind class, considering competing demand and a discount for “developability”
- Subject to import limitations

Wind Projects - Characterization

Capital Costs

- Reference balance of plant construction costs developed for several types of project sites
  - Flat terrain, several rows of turbines
  - Intermediate terrain types
  - Mountainous terrain, turbines on ridgeline
- Wind turbine price assumed to be uniform for all project types
- Cost adjustment for distance of site from major roads and highways

Wind Projects - Characterization

Plant Performance

Performance characteristics will be based on the California speed wind map

- Capacity determined by amount of land (sq. mi.) available at each wind speed
- Capacity factor calculated based on California wind maps (adjusted to 80-m hub height)
- General wind turbine power curves used
  - Representative power curves for IEC design classes (I, II, and III)
  - Adjustment of power curves based on average temperature in area and project site elevation
- Losses applied, wake losses based on terrain type and project size
- Production profile by region from wind map

Biomass Projects - Siting

Proxy Projects

- California Biomass Collaborative 2010 technically feasible capacity by county as basis for supply
  - Breakdown by agricultural residues, forest residues, and urban wood waste; subdivisions in each
- Determined maximum potential MW from supply using 80% capacity factor and 13,650 BTU/kWh heat rate
  - Reduced by assuming 1/3rd of maximum supply available for power generation (remainder for other purposes or potentially too expensive)
  - Minimum project size set at 20 MW for economic feasibility

Biomass Projects - Siting

Proxy Projects

- Determined if specific subtypes of biomass could meet 20 MW threshold; if not, grouped together
  - Example: Vegetable crop subtype of agriculture
- If none of the three major types of biomass within a county can meet the 20 MW threshold, group together in a multi-fuel plant
  - Urban wood waste held separate due to properties
- Use remaining material to consider plants at county borders
- Assume siting near major county substations

Biomass Project Examples (Single County)

Project	County	Generation Capacity (MW)	Biomass Fuel(s)
1	Butte	22	Composite Agricultural Residues
2	Colusa	23	Field/Seed Crop Residues
3	El Dorado	32	Composite Wood Residues
4	Fresno	24	Field/Seed Crop Residues
5	Fresno	22	Multifuel
6	Fresno	20	Orchard/Vineyard Residues
7	Glenn	22	Composite Agricultural Residues
8	Humboldt	61	Forest Thinnings/Slash
9	Kern	21	Field/Seed Crop Residues
10	Kern	30	Multifuel
11	Kings	21	Field/Seed Crop Residues
12	Lassen	39	Composite Wood Residues

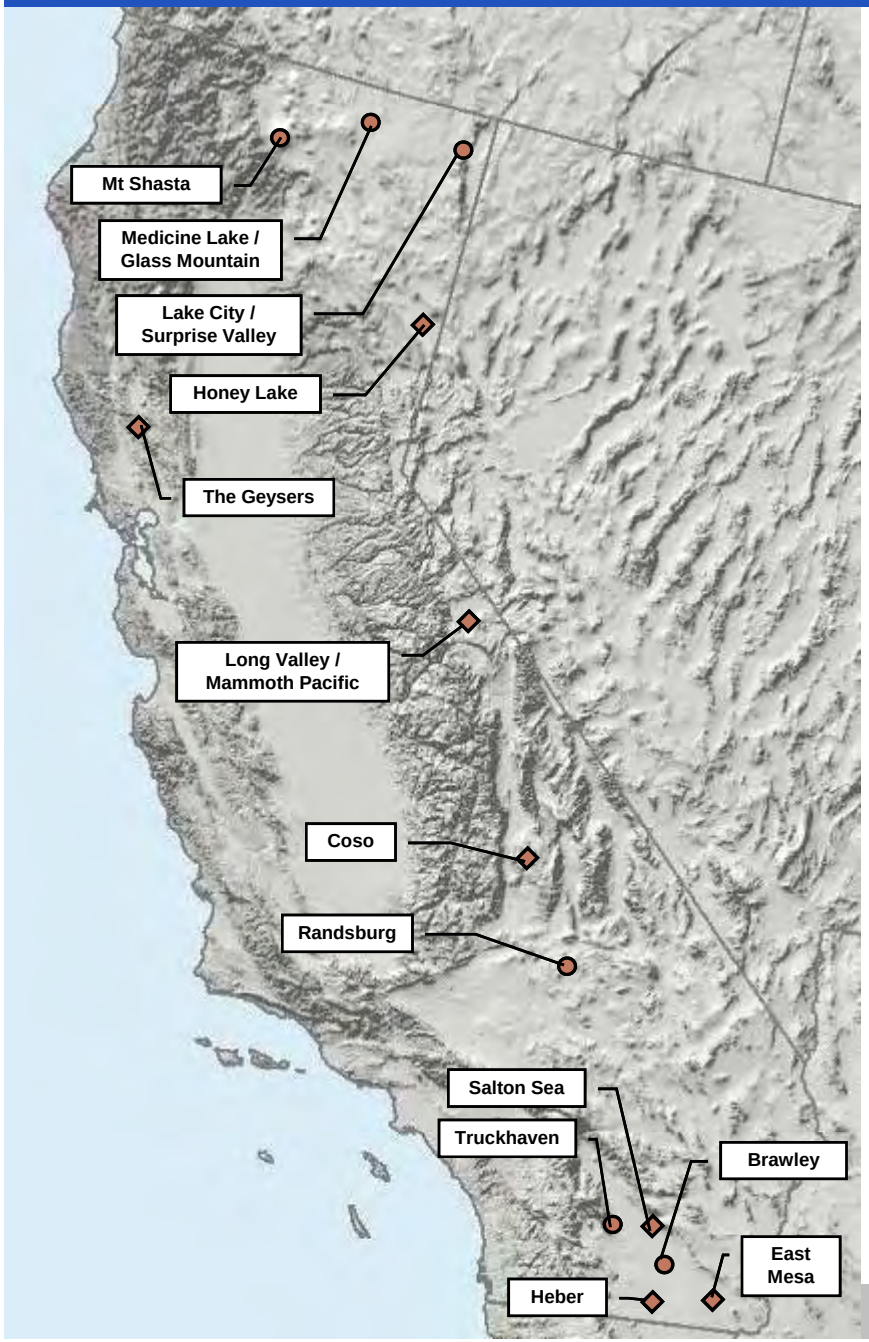
Biomass Project Examples (Multiple County)

Project	Central County	Additional Counties	Generation Capacity (MW)	Biomass Fuel(s)
6		Amador, Calaveras	24	Multifuel
7		Yolo, Colusa	26	Multifuel
8		Butte, Yuba	32	Multifuel
9		Del Norte, Humboldt	25	Multifuel
10		San Diego, Imperial	33	Multifuel
11		San Bernadino, Riverside, LA	28	Multifuel
12		Inyo, Tulare	20	Multifuel
13		Lake, Napa, Solano	32	Multifuel
14		Mendocino, Sonoma, Marin	21	Multifuel
15		Mariposa, Stanislaus	24	Multifuel
16		SLO, Santa Barbara, Ventura	21	Multifuel
17		Nevada, Sierra	29	Multifuel
18		Placer, Sacramento	27	Multifuel
19		Monterey, San Benito, Santa Cruz, Santa Clara	24	Multifuel

Biomass Projects - Characterization

Plant Performance

- Capital cost to be based on a $/kW basis for biomass, function of scale and fuel type
- Operating cost largely driven by feedstock. Will set a cost per feedstock type, sensitive to any counties with remote sources
  - Cost of environmental credits evaluated per county. Has impacted siting (example: SCAQMD)
- Heat rate – function of fuel type (moisture content)



Geothermal

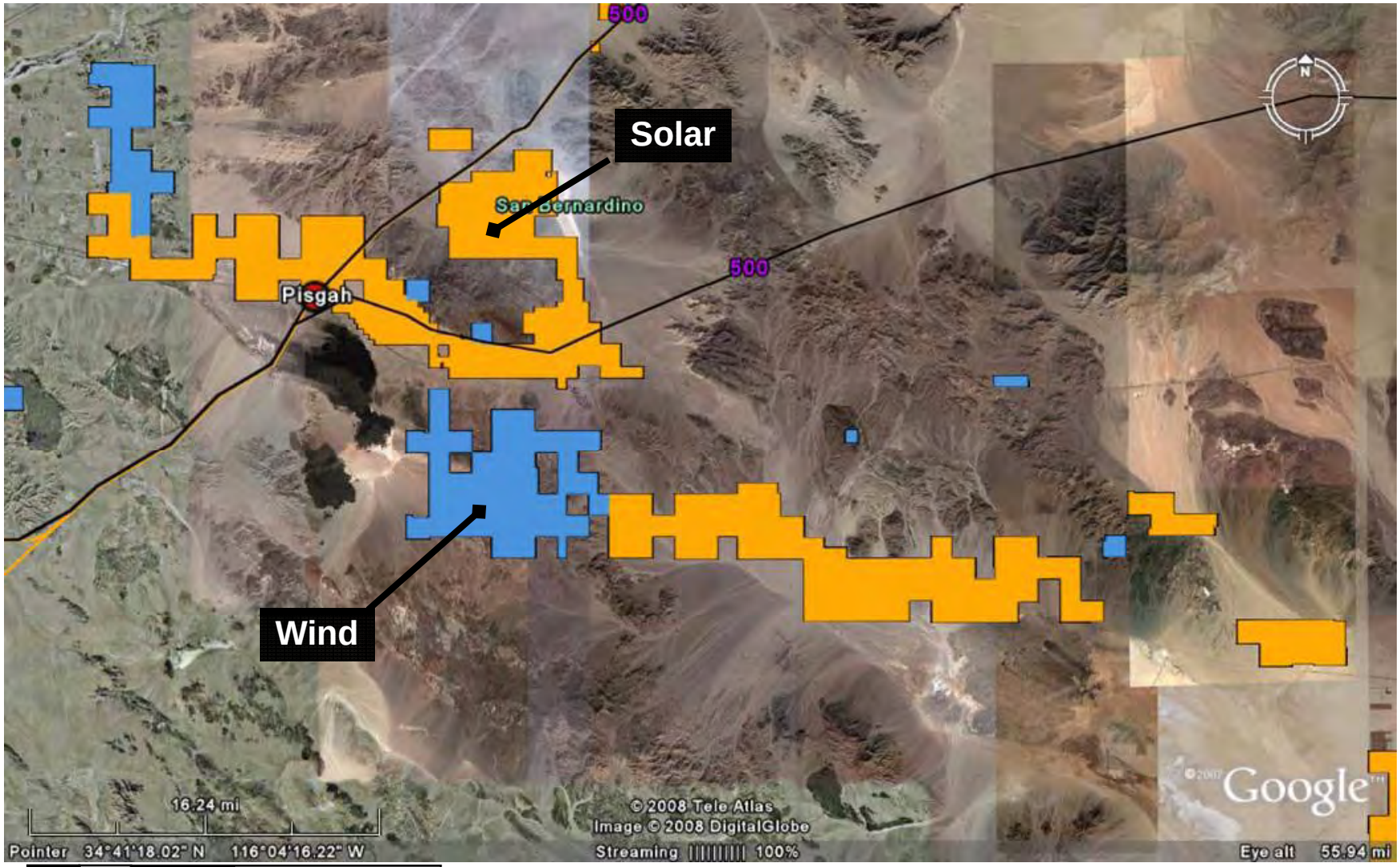
- Geothermal assessment performed by GeothermEx
- California and Nevada estimates based on past GeothermEx work
- Estimates for other regions rely on multiple data sources

Example Project Identification for Pisgah

- Hypothetical Supra-CREZ around Pisgah
- Wind and solar resources

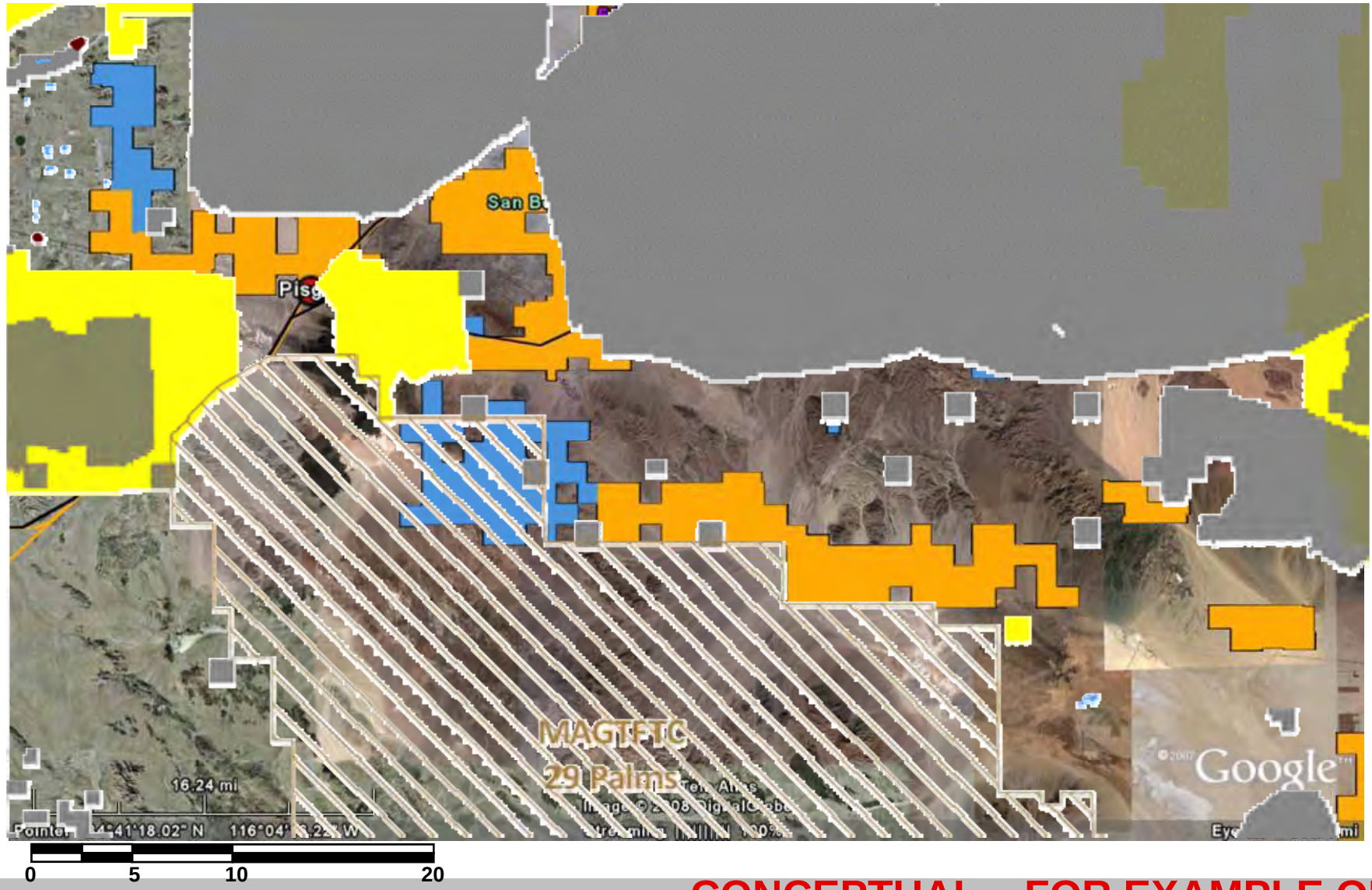
- This example was created to explain process before we started the actual project ID, which is currently in process

Pre-Identified Projects (Partial)



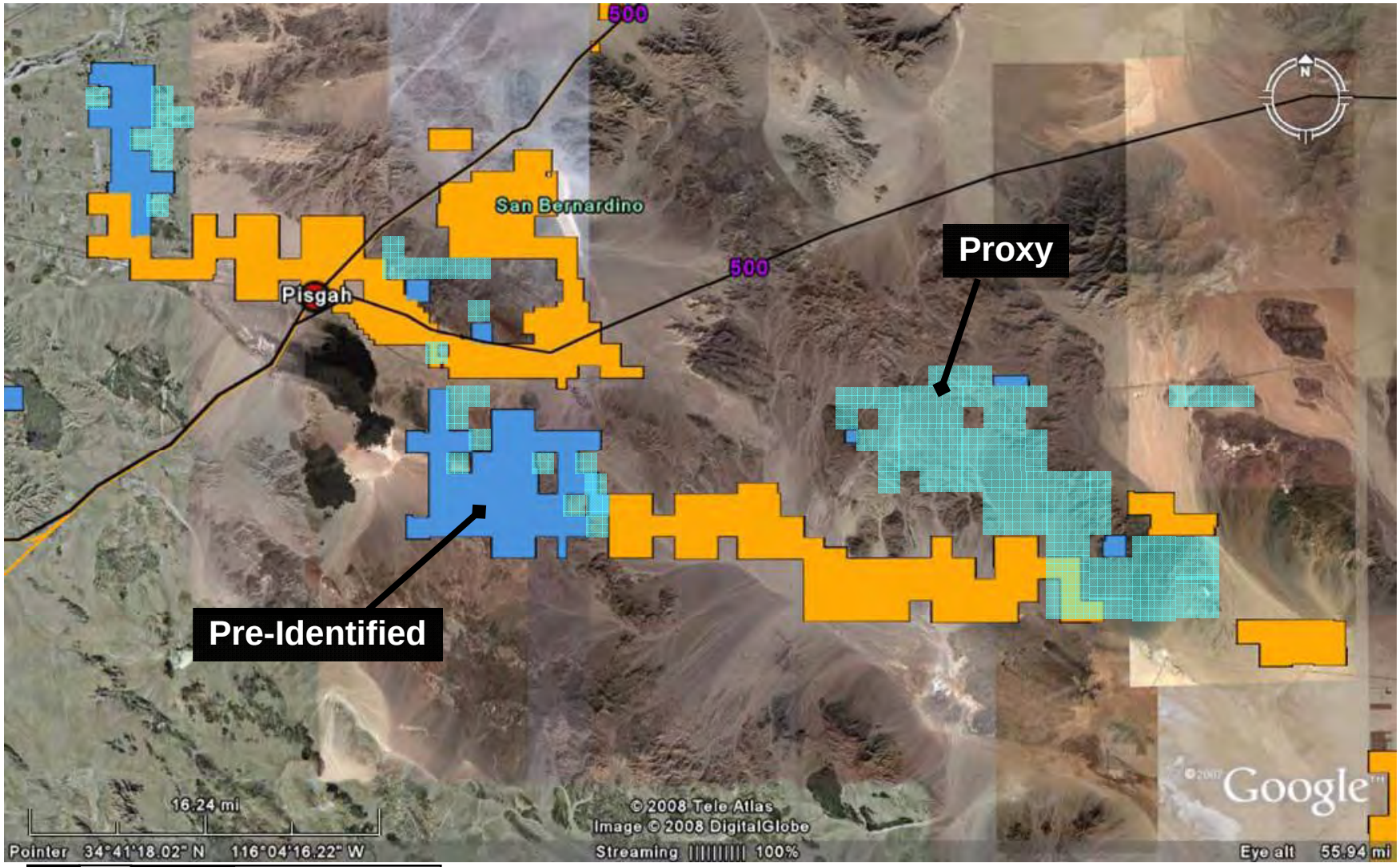
CONCEPTUAL – FOR EXAMPLE ONLY

Land Restrictions



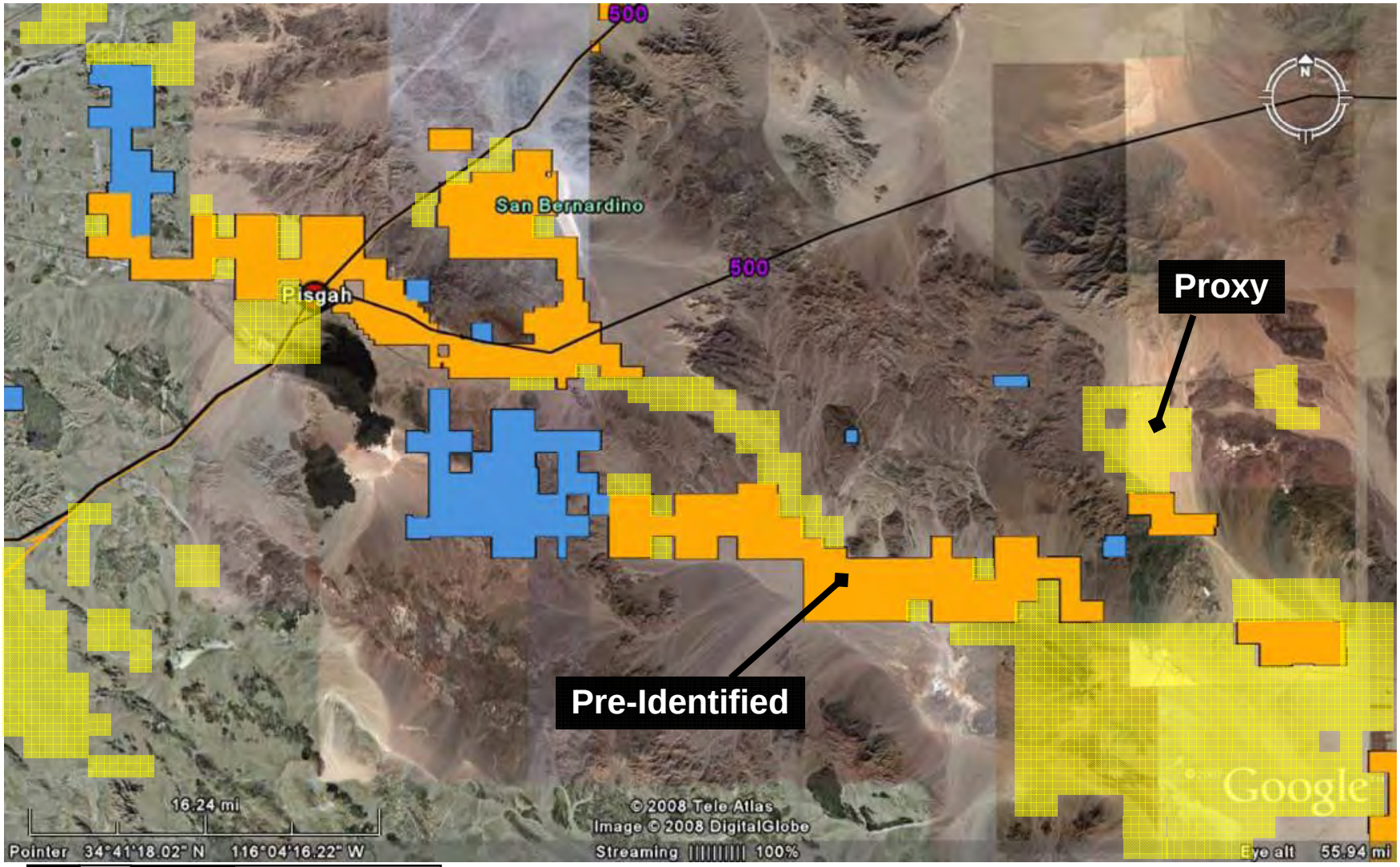
CONCEPTUAL – FOR EXAMPLE ONLY

Candidate Land – Wind



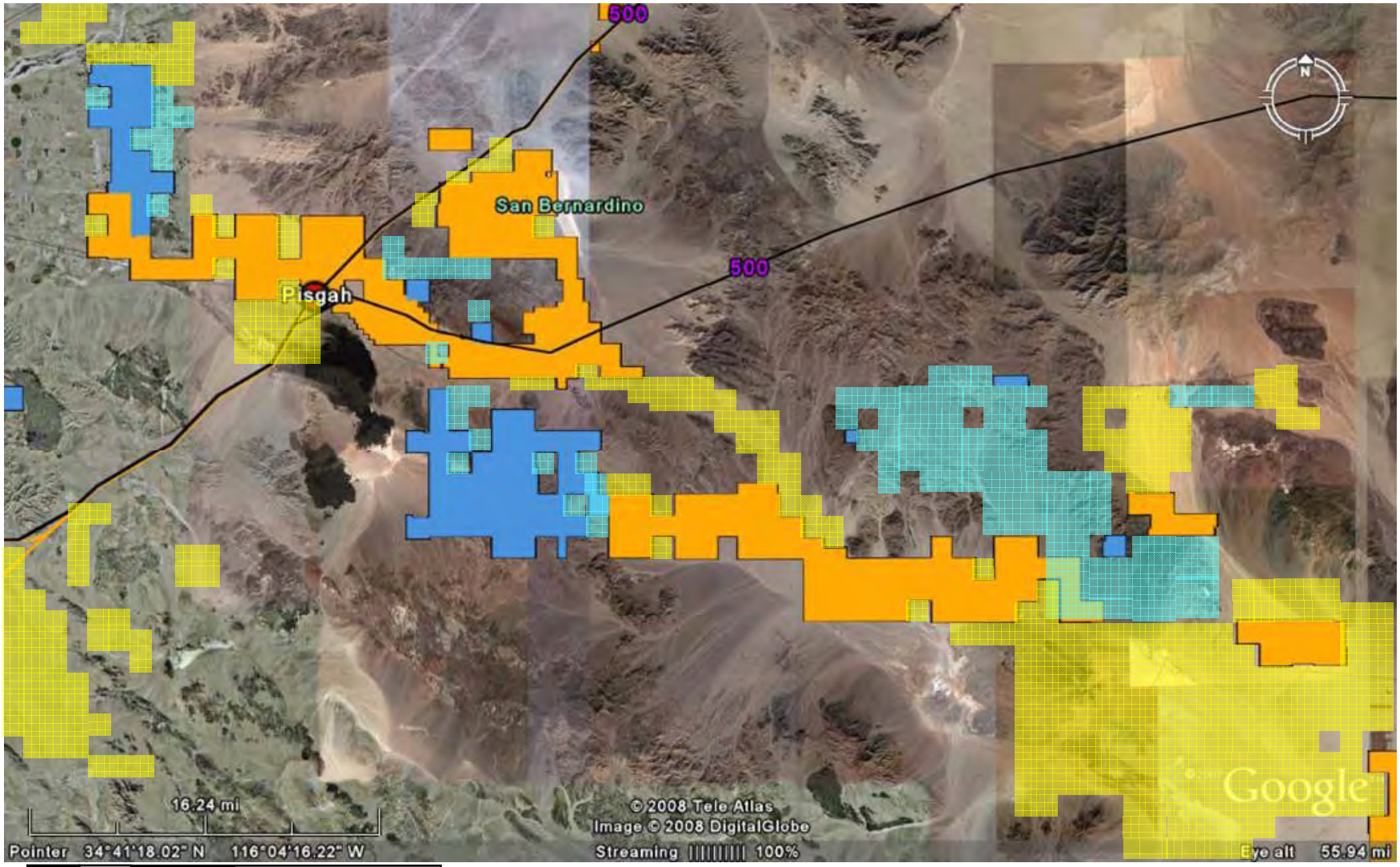
CONCEPTUAL – FOR EXAMPLE ONLY

Candidate Land – Solar



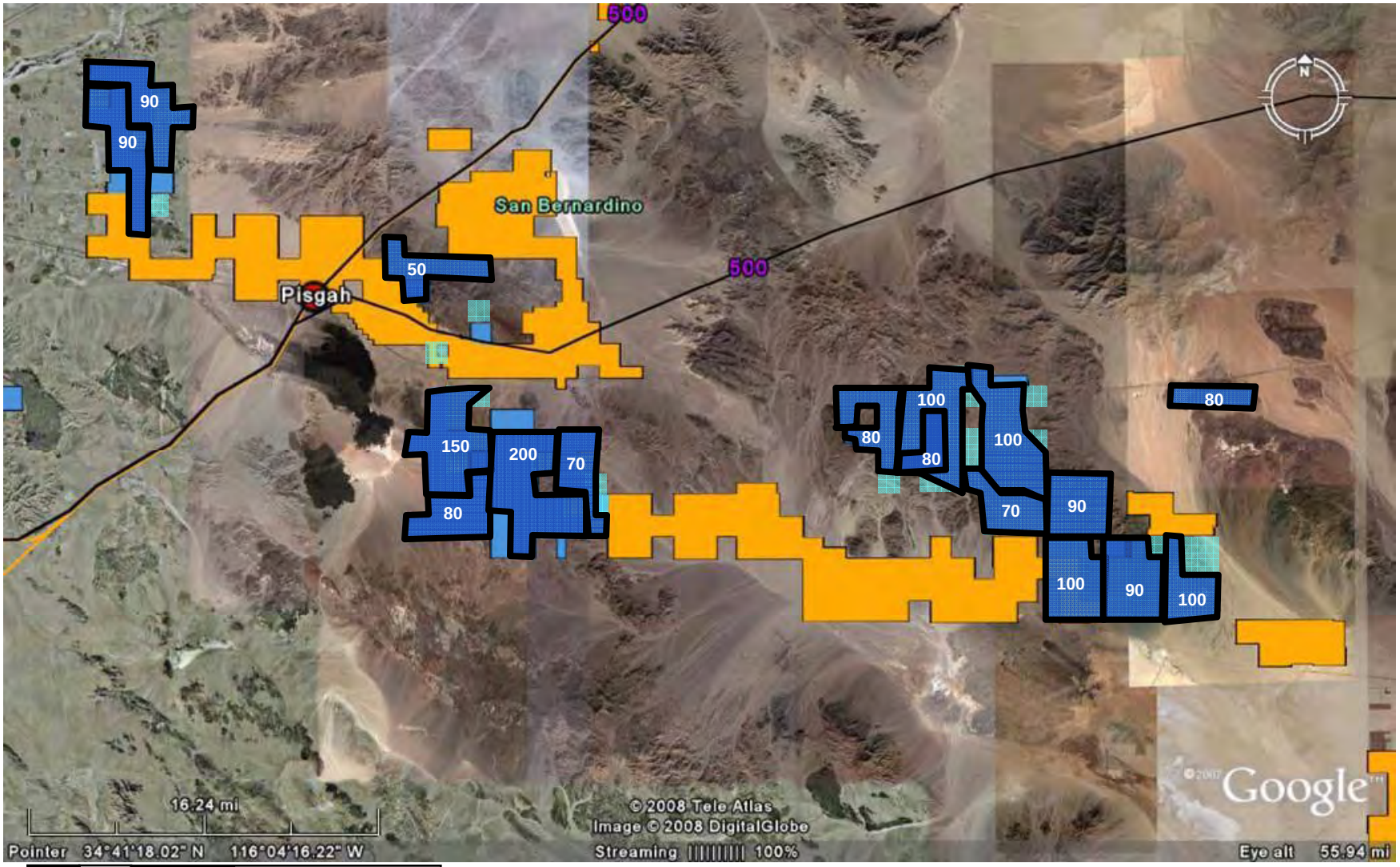
CONCEPTUAL – FOR EXAMPLE ONLY

Candidate Land – Solar & Wind



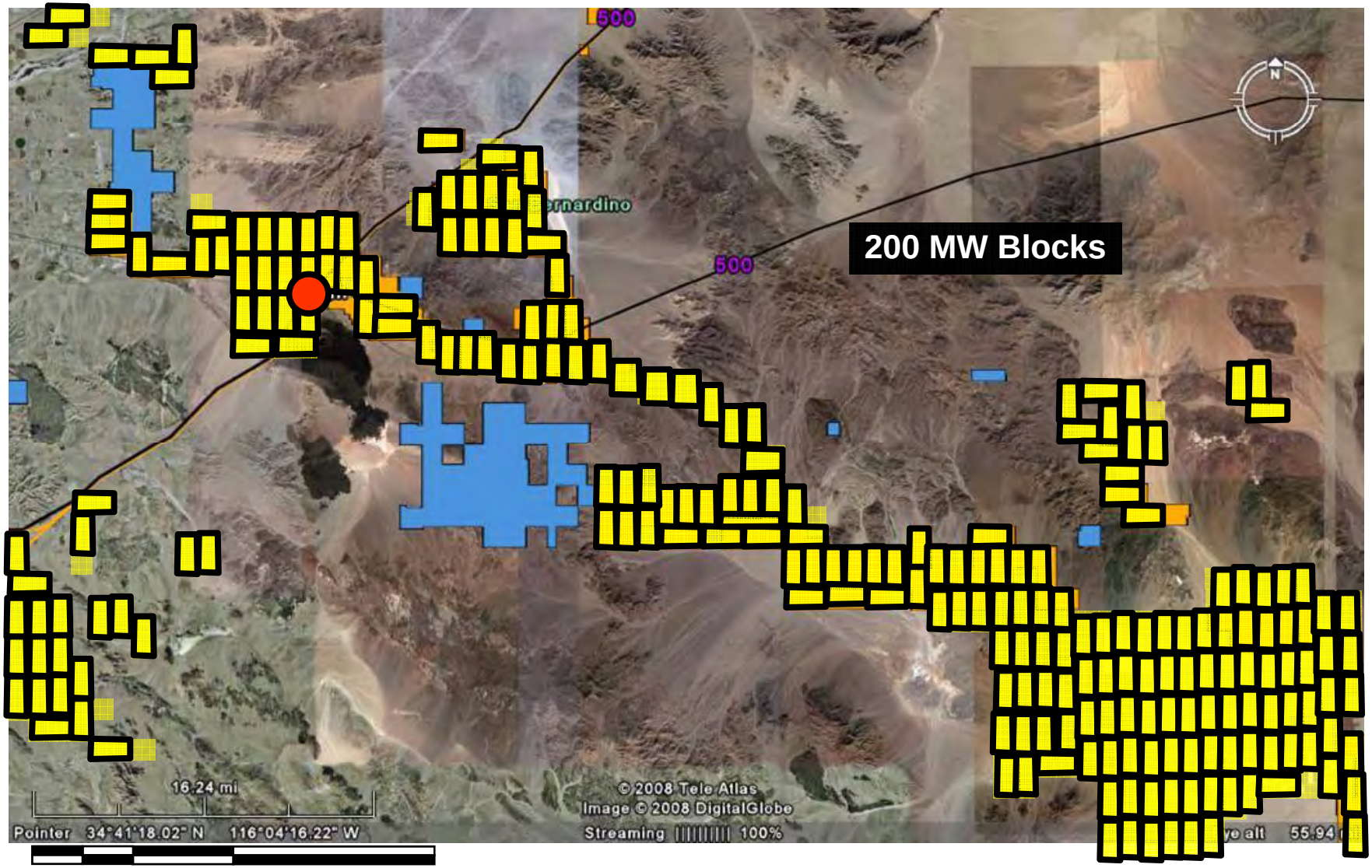
CONCEPTUAL – FOR EXAMPLE ONLY

Project ID – Wind (1620 MW)



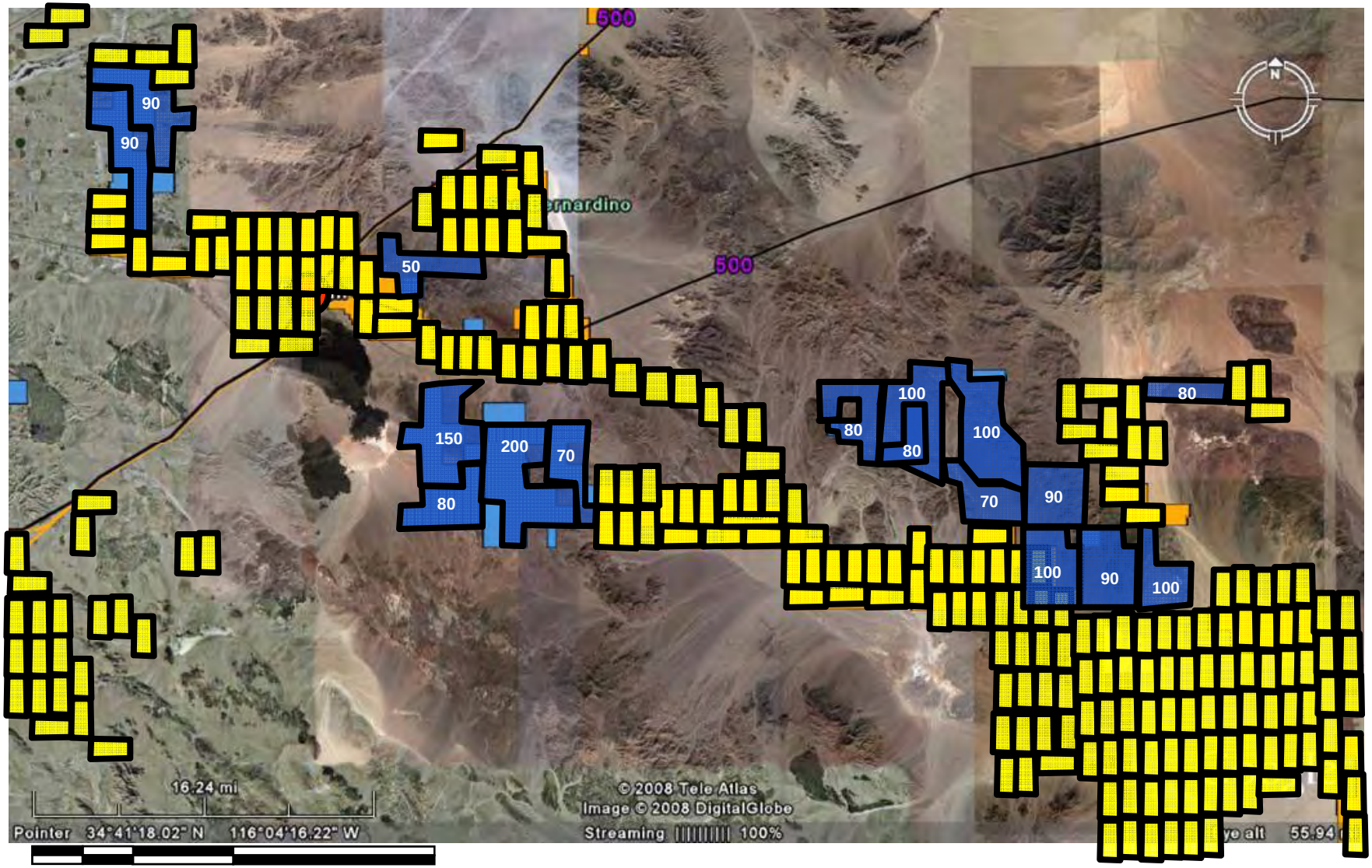
CONCEPTUAL – FOR EXAMPLE ONLY

Project ID – Solar (48,600 MW)



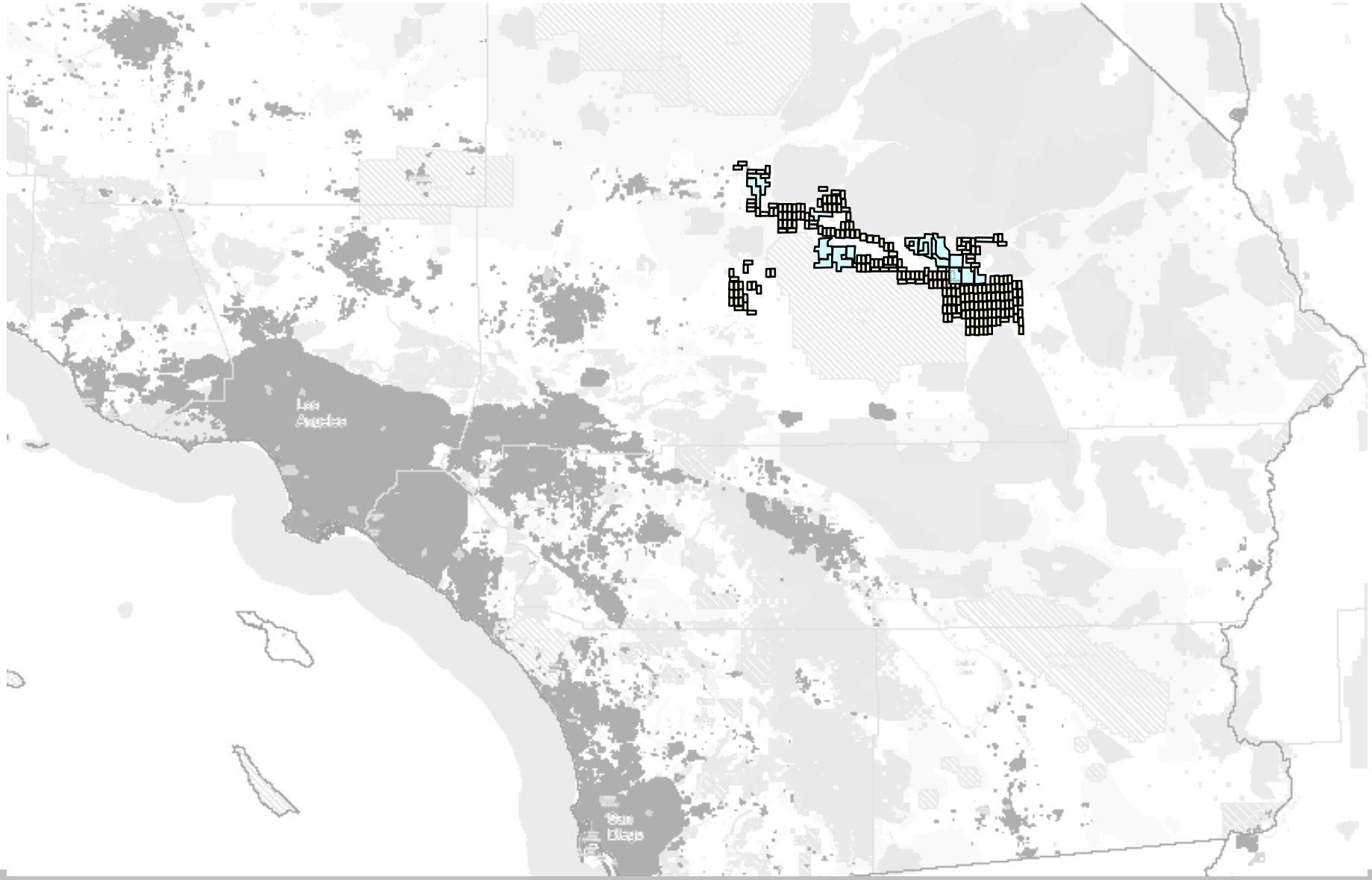
CONCEPTUAL – FOR EXAMPLE ONLY

Project ID – Wind & Solar (50,220 MW)

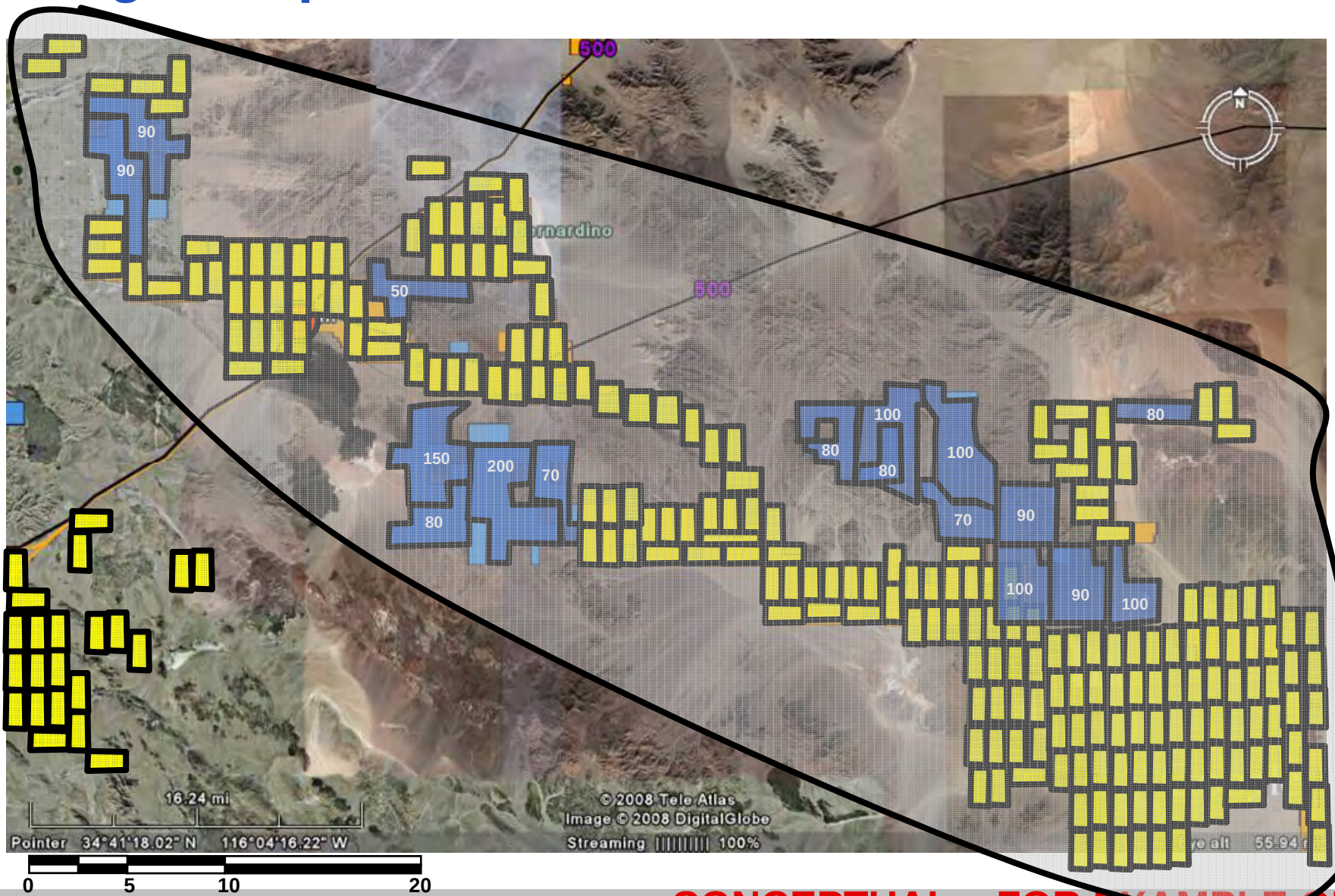


CONCEPTUAL – FOR EXAMPLE ONLY

Sense of Scale

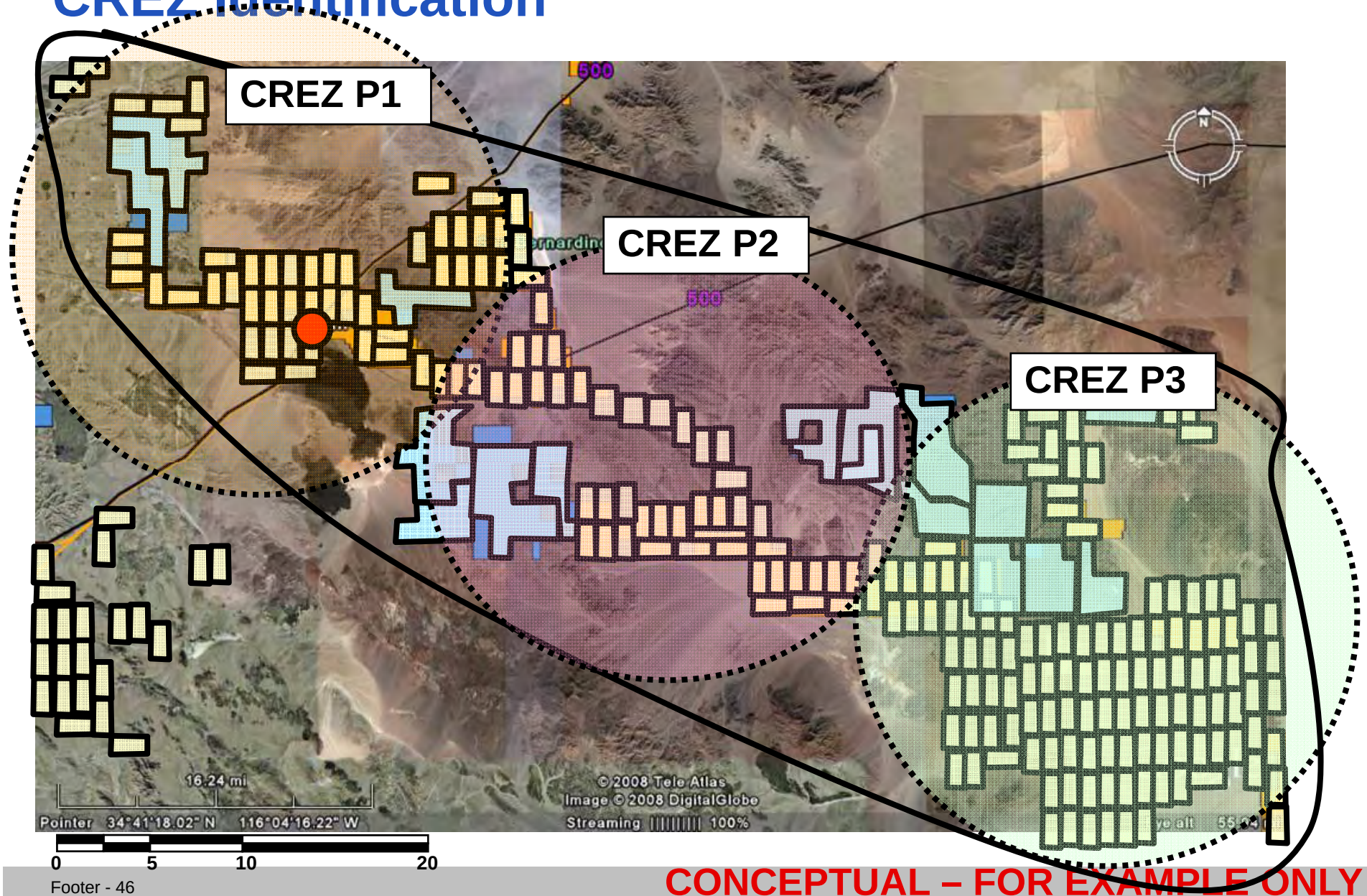


Pisgah Supra-CREZ Identification



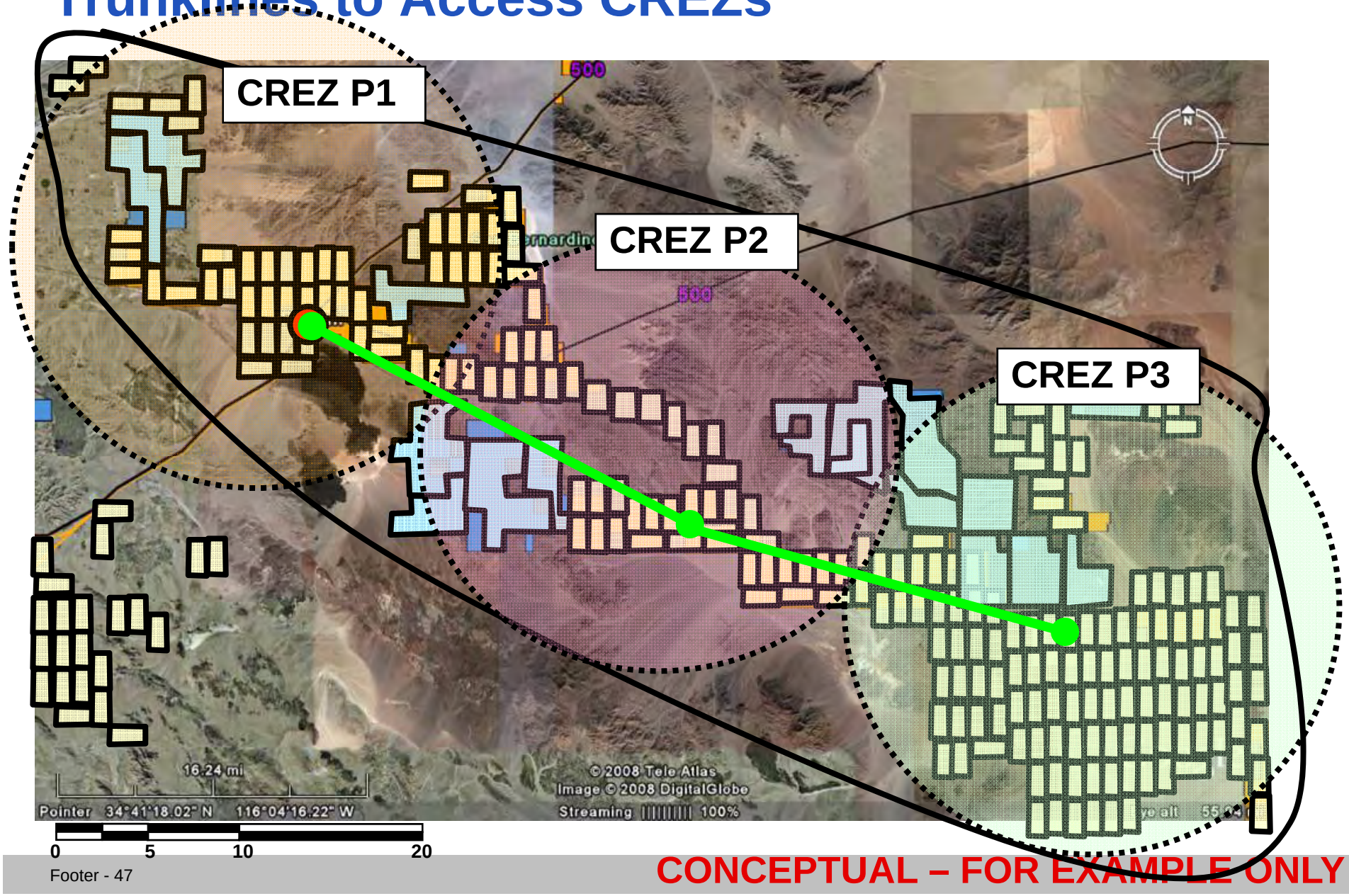
CONCEPTUAL – FOR EXAMPLE ONLY

CREZ Identification



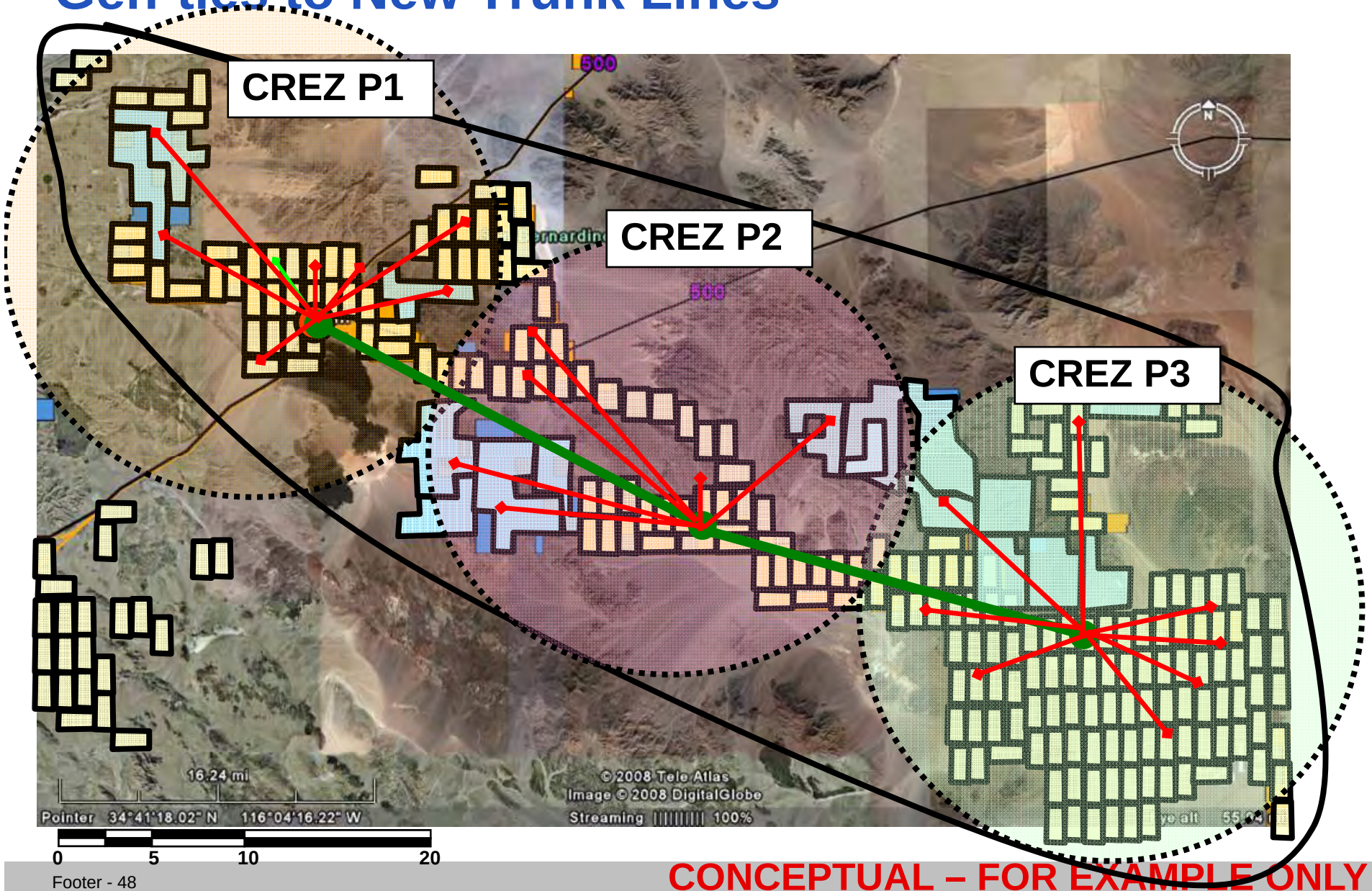
CONCEPTUAL – FOR EXAMPLE ONLY

Trunklines to Access CREZs



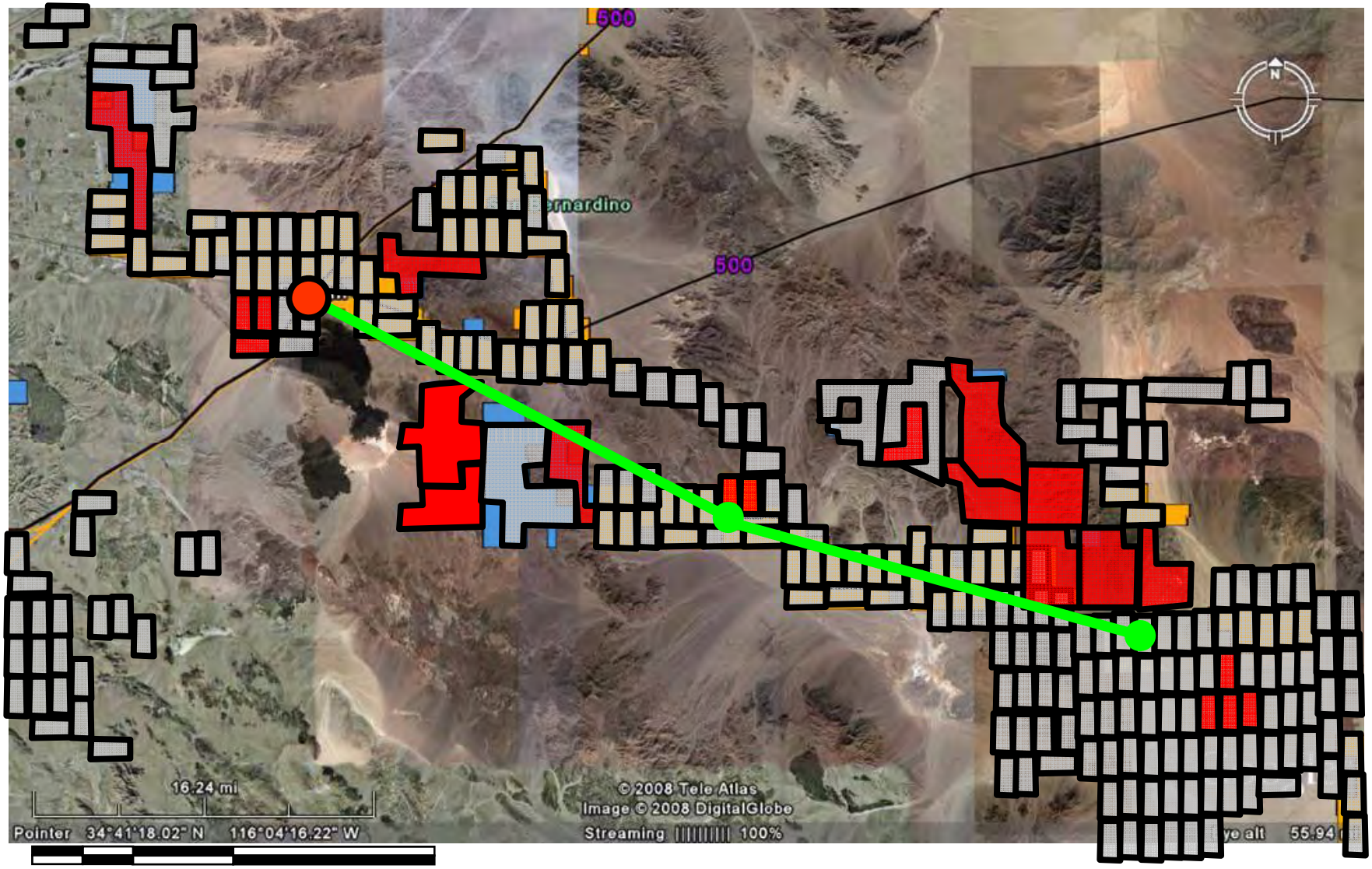
CONCEPTUAL – FOR EXAMPLE ONLY

Gen-ties to New Trunk Lines



CONCEPTUAL – FOR EXAMPLE ONLY

Hypothetical Best Projects



CONCEPTUAL – FOR EXAMPLE ONLY

Development Timeframe

- Near term: before 2013
- Mid term: 2013-2016
- Long term: 2017-2020

Development Timeframe Linked to Transmission

Transmission Timing	Timeframe	Project Type	
		Pre-Identified	Proxy Projects
Existing Transmission	N/A	near	near
Approved Transmission	2009-2012*	near	mid
Proposed Transmission	2013-2016*	mid	mid
New Transmission	2017-2020	long	long

* Timeframe assignment is typical. Will vary depending on specific transmission project timing

"Approved" Transmission (RETI Base Case)

- Tehachapi 1-3
- Tehachapi 4-11
- Sunrise Powerlink
- Devers – Palo Verde 2
- IID - Dixieland
- IID - Midway-Bannister

Proposed Transmission

- TANC Projects
  - Alpha
  - Zeta
- PG&E
  - Central California Clean Energy Transmission
  - BC Link
- IID - PV-Yuma
- IID - CV – Devers
- Etc.

New Transmission

- All other not-identified
- Other regional transmission links

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Thank You!

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